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MONTANA REFERENCE STREAMS:

1993 AQUATIC MACROINVERTEBRATE SURVEYS

prepared for the

Montana Department of
Health and Environmental Sciences

Helena, MT

prepared by

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Introduction

The Montana Department of Health and Environmental Sciences (MDHES) has conducted macroinvertebrate surveys of least-impacted reference streams since 1990. The reference stream program was described by Bahls et al. (1992). Previous macroinvertebrate studies (Wisseman 1992, McGuire 1992) produced first generation metrics and criteria for evaluating biological integrity in montane, plains, and foothills and valleys regions. These surveys provide baseline data for gauging the success of pollution control projects.

This report presents and evaluates 1993 data from 10 reference streams (Table 1). Samples were collected from five mountain and four plains streams. Armstrong Spring Creek was the only spring creek in the "foothills and valleys" ecoregion sampled in 1993.

Methods

Field

Field work was conducted by Montana Water Quality Bureau (WQB) personnel. Sampling locations were those established in 1990. Macroinvertebrates were collected from riffle habitats using a standardized traveling kick-net technique (Bukantis 1994). In most cases, a single sample was collected from each stream; however, triplicate samples were obtained from the Boulder and West Fork Poplar River.

Laboratory

Laboratory and data analysis were contracted to McGuire Consulting. A 300 organism subsample was obtained from each sample using RBP III sorting methodology (Plafkin et al. 1989 - Appendix B.2). Macroinvertebrates were identified to the lowest practical taxonomic level, usually genus or species.

Table 1. Montana reference streams sampled in 1993.

Ecoregion	Stream	Tributary of	General location	Sampling location	Water class
Northern Rockies (#15)					
	Seymour Cr.	Big Hole R.	Anaconda Range	T3N R13W Sec 9	A-1
	S. F. Sun R.	Sun R.	Lewis & Clark Co.	T20N R10W Sec 8	A-1/B-1
	N. F. Teton R.	Teton R.	Teton Co.	T25N R9W Sec 16	A-1/B-1
Middle Rockies (#17)					
	W. F. Stillwater R.	Stillwater R.	Sweet Grass Co.	T5S R14E Sec 14	A-1
	Boulder R. (4th order)	Yellowstone R.	Sweet Grass Co.	T6S R12E Sec 28	A-1
Northern Montana Glaciated Plains (#41)					
	Rock Cr. nr. Hinsdale	Milk R.	Valley Co.	T36N R3E Sec 8	B-3
	Battle Creek	Milk R.	Blaine Co.	T33N R19E Sec 3	B-3
Northwestern Great Plains (#43)					
	W. F. Poplar R. (3rd order)	Poplar R.	Daniels Co.	T32N R48E Sec 2	B-2
	Redwater R.	Missouri R.	McCone Co.	T25N R50E Sec 23	C-3
Montana Valley & Foothill Praires (#16)					
	Armstrong Spring Cr.	Yellowstone R.	Park Co.	T3S R9E Sec 26	B-1

Data Analysis

Community composition, structure and function were characterized for each sample using a variety of potential metrics (Table 2). Descriptions, rationales and formulas for these metrics can be found in Wisseman (1992), McGuire (1992, 1993, 1994) and the references included in the Table 2. Taxonomic levels, functional feeding group designations and tolerance values used to calculate metrics were taken from previous studies as cataloged by Bukantis (1994).

The 1990 and 1991 data were reviewed and minor changes were made in taxonomy, functional designation and tolerance values to conform with Bukantis (1994). Some of the older data were based on subsamples of considerably more or less than 300 organisms. Where possible, taxa and EPT richness values were normalized to the standard 300 organism subsample. Metric values were recalculated and incorporated into a three year database for each ecoregion. Data summaries included means, ranges, average deviations from the mean, and relative percent difference (R%Dif) for selected metrics.

Similarity indices were used to evaluate community composition within and among streams during 1993. Average-linkage cluster analyses (Hellawell 1978) provided graphic representations of these data. Variability within stream reaches was evaluated using triplicate samples from the Boulder and West Fork Poplar Rivers. These data were used to document inherent sample variability and to examine the number of samples required for reliable characterizations of macroinvertebrate assemblages.

Table 2. Metrics used to characterize aquatic macroinvertebrate assemblages in Montana reference streams.

Metric	Reference
Community structure	
Taxa richness	Plafkin et al. (1989)
EPT richness	Plafkin et al. (1989)
Shannon diversity	Weber (1973)
% dominant taxon	Plafkin et al. (1989)
Indicator organisms	
Biotic index	Hillsenhoff (1989)
Metals tolerance index	McGuire (1993)
% Chironomidae	
% EPT	
EPT/EPTC	Plafkin et al. (1989)
% Baetidae of Ephemeroptera	
% Hydropsychinae of Trichoptera	
Similarity Indices	
Dominants in common (DIC-5)	Shackleford (1988)
Qualitative Similarity Index (QSI-taxa)	Shackleford (1988)
Qualitative Similarity Index (QSI-FFG)	Shackleford (1988)
Community function	
% Collectors - Gatherers	
% Collectosr - Filterers	
% Collectors - (gatherers + filterers)	
% Shredders	Plafkin et al. (1989)
% Scrapers	
% Scrapers + Shredders	
Scrapers/(Scrapers + Filterers)	Plafkin et al. (1989)
% Predators	

Results and Discussion

The 1993 data, including identifications, metric values and summary statistics are presented in Appendix A.

PLAINS ECOREGION

Four plains reference streams were sampled in 1993. Single samples were obtained from the Redwater River, Battle and Rock creeks while three samples were collected from the West Fork Poplar River.

Community composition

Faunal similarity within and among streams was evaluated using three similarity indices (Table 3). The Qualitative Similarity Index (QSI-taxa) appeared to be the most informative of the three metrics. This metric describes taxonomic similarity between two samples. QSI values can range from 0%, when no taxa are common to the two samples, to 100% when all taxa are present in the same proportion in both samples.

Benthic community composition was generally dissimilar among plains streams and, consequently, QSI values were usually low (Table 3). A cluster analysis of the QSI-taxa values provided a graphic representation of these data (Figure 1). QSI values between streams averaged 27% and ranged from 12 to 69%. Benthic communities were most similar in Battle and Rock creeks. A predominance of blackflies, which usually indicates organic enrichment, accounted for the relatively high QSI value between these two streams. Therefore, Battle and Rock creeks may be water quality-impaired and may not be appropriate as reference streams. Alternatively, both streams are tributaries to the Milk River and their relative proximity may account for the similarity between faunas.

The low similarity values between most reference streams suggested that it may not be possible to construct a single reference community for the plains ecoregion and that similarity indices should not be used as metrics without a site specific reference. Nevertheless, similarity indices provide valuable information for environmental assessment and monitoring. The QSI can be used to document year-to-year variability at specific sites and to provide a preliminary grouping of streams within an ecoregion.

Within the West Fork Poplar River, QSI values averaged 73%. Community composition was similar in all three riffles and indicated that a single sample would probably provide an adequate characterization of the fauna for a coarse assessment of environmental condition.

Metrics

Potential metrics were summarized using three years of data. For individual metrics, mean site-specific variability over three years ranged from 12 to 85% (Table 4). Site-specific variability was less than 30% for five potential metrics: % collectors, biotic index, taxa richness, Shannon diversity and EPT richness. The relatively high site-specific variability of other potential metrics may actually reflect varying degrees of environmental stress during the study period. Drought conditions in 1990 appeared to be reflected in some metric values and increased the variability of % EPT, % Chironomidae, % dominant taxon and functional group metrics.

Metric means, ranges and overall variability for plains reference streams are presented in Table 5. Relative Percent Differences (R%Dif) ranged from 13% for the biotic index to 130% for the % Scrapers. While high variability among and within reference sites does not necessarily preclude the use of a metric in an RBP assessment, it makes the selection of appropriate and widely applicable scoring criteria difficult. At this time, the metrics and criteria used by McGuire (1994) are recommended for general plains ecoregion assessments.

Table 3. Similarity indice values for plains and mountain reference streams during 1993.

Plains Reference Streams

QSI-taxa	WFPop 1	WFPop 2	WFPop 3	Battle	Redwater
WF Poplar 2	79				
WF Poplar 3	64	76			
Battle Cr.	7	14	23		
Redwater R.	14	17	22	32	
Rock Cr.	9	9	18	69	14

QSI-ffg	WFPop 1	WFPop 2	WFPop 3	Battle	Redwater
WF Poplar 2	90				
WF Poplar 3	75	70			
Battle Cr.	22	32	48		
Redwater R.	33	40	22	83	
Rock Cr.	26	36	52	94	84

DIC-5	WFPop 1	WFPop 2	WFPop 3	Battle	Redwater
WF Poplar 2	3				
WF Poplar 3	3	4			
Battle Cr.	0	1	2		
Redwater R.	1	1	1	3	
Rock Cr.	0	0	1	2	1

Mountain Reference Streams

QSI-taxa	Boulder 1	Boulder 2	Boulder 3	WF Stillw	Seymour	SF Sun
Boulder 2	70					
Boulder 3	80	79				
WF Stillwater	60	64	66			
Seymour Cr	41	48	49	56		
SF Sun	32	48	38	36	30	
NF Teton	45	51	47	51	40	42

QSI-ffg	Boulder 1	Boulder 2	Boulder 3	WF Stillw	Seymour	SF Sun
Boulder 2	82					
Boulder 3	95	86				
WF Stillwater	88	94	92			
Seymour Cr	78	95	82	91		
SF Sun	83	93	87	95	91	
NF Teton	82	67	78	72	66	70

DIC-5	Boulder 1	Boulder 2	Boulder 3	WF Stillw	Seymour	SF Sun
Boulder 2	3					
Boulder 3	3	4				
WF Stillwater	2	3	2			
Seymour Cr	1	2	1	3		
SF Sun	1	1	1	2	2	
NF Teton	3	2	2	2	2	2

Figure 1. Average linkage cluster analysis of percent community similarity values within and among plains reference streams in 1993.

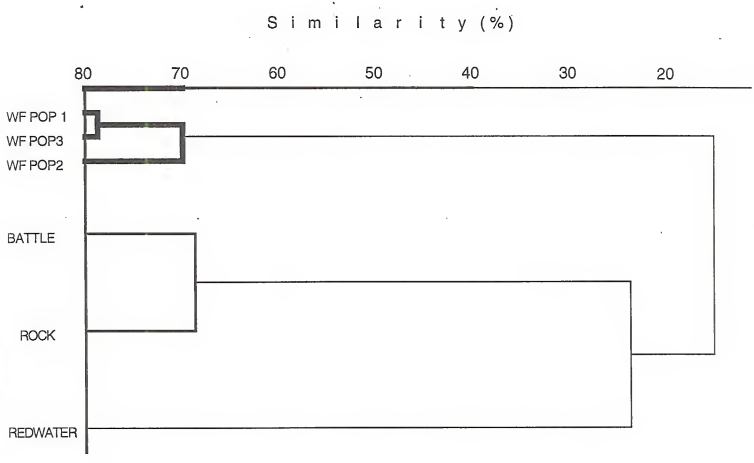

Table 4. Metric variability in Plains ecoregion reference streams over three years.

Metric	STREAM				Mean	Metric	STREAM				Mean
	WF Pop	Redwater	Rock	Battle	R%Dif		WF Pop	Redwater	Rock	Battle	R%Dif
Taxa richness						EPT richness					
1990	24	11	37			1990	7	1	4		
1991	18	13	23			1991	10	3	3		
1993	23	13	13	14		1993	11	6	3	7	
AveDif	2.6	0.9	8.4			AveDif	1.5	1.8	0.4		
R%Dif	12%	7%	35%		18%	R%Dif	16%	53%	13%		28%
% Hydropsychinae-Trichoptera						% Baetidae-Ephemeroptera					
1990	81	100	50			1990	80	0	5		
1991	2	100	100			1991	37	100	13		
1993	65	99	75	100		1993	20	58	0	38	
AveDif	32	1	25			AveDif	23	50	7		
R%Dif	64%	1%	33%		33%	R%Dif	50%	95%	109%		85%
S. diversity						% Dominant					
1990	2.6	2.9	4.3			1990	56	31	14		
1991	2.8	1.1	2.8			1991	35	77	50		
1993	3.2	2.5	1.4	2.0		1993	34	39	78	60	
AveDif	0.2	0.7	1.0			AveDif	10	19	22		
R%Dif	8%	33%	35%		25%	R%Dif	23%	38%	47%		36%

Table 4. Metric variability in Plains ecoregion reference streams over three years.

Metric	STREAM				Mean	Metric	STREAM				Mean
	WF Pop	Redwater	Rock	Battle	R%Dif		WF Pop	Redwater	Rock	Battle	R%Dif
% Chironomidae						EPT/EPTC					
1990	12	48	53			1990	0.62	0.14	0.13		
1991	1	12	65			1991	0.96	0.87	0.16		
1993	7	11	7	5		1993	0.92	0.86	0.31	0.85	
AveDif	4	16	23			AveDif	0.14	0.32	0.07		
R%Dif	57%	69%	55%		60%	R%Dif	17%	52%	37%		35%
Biotic index						% EPT					
1990	6.7	7.5	7.2			1990	18	8	10		
1991	6.0	5.2	6.1			1991	33	85	12		
1993	4.6	5.4	7.1	5.3		1993	78	69	3	30	
AveDif	0.8	1.0	0.5			AveDif	23	31	4		
R%Dif	13%	16%	7%		12%	R%Dif	54%	57%	43%		51%
% Collectors-gatherers						% Scrapers					
1990	14	62	60			1990	1	0	0		
1991	14	14	72			1991	6	0	1		
1993	51	18	12	15		1993	19	0	2	1	
AveDif	16	20	24			AveDif	7	0	1		
R%Dif	62%	65%	50%		59%	R%Dif	79%	#DIV/0!	67%		#DIV/0!
% Collectors (g + f)						% Scrapers + Shredders					
1990	85	64	71			1990	8	8	10		
1991	65	98	78			1991	35	0	2		
1993	68	84	91	98		1993	24	0	3	1	
AveDif	8	12	7			AveDif	10	4	3		
R%Dif	11%	15%	9%		12%	R%Dif	43%	133%	67%		81%

Table 5. Summary of metric values for plains reference streams in Montana.

METRIC	MEANS 1990	1991	1993	all	min	max	Ave Dif	R%Dif
n=	3	3	4	10				
Taxa richness	24	18	16	19	11	37	6	34%
EPT richness	4	5	7	6	1	11	3	49%
Biotic index	7.1	5.8	5.6	6.1	4.6	7.5	0.8	13%
% dominant	34	54	53	47	14	78	17	36%
Shannon diversity	3.3	2.3	2.3	2.6	1.4	4.3	0.6	23%
% Chironomidae	38	26	8	22	1	65	20	90%
% EPT	12	43	45	35	3	85	26	74%
EPT/EPTC	0.30	0.66	0.74	0.58	0.13	0.96	0.32	55%
%Baetidae-Ephem.	27	50	19	31	0	100	26	84%
%Hydropsychinae-Trich	77	67	85	77	2	100	23	30%
% Collector-gatherer	45	33	24	33	12	72	23	68%
% Collector-filterer	28	48	62	48	2	88	31	65%
% Collector (G+F)	73	81	86	81	64	99	11	14%
% Scraper	0	2	6	3	0	19	4	130%
% Shredder	8	10	2	6	0	29	6	92%
% Scraper+Shredder	9	12	7	9	0	35	8	89%
Scraper/(Scrap+Filt.)	0.01	0.08	0.15	0.09	0.00	0.57	0.11	124%

MOUNTAIN ECOREGION

Five mountain reference streams were sampled in 1993. Single samples were obtained from Seymour Creek, North Fork Tetón, South Fork Sun, and West Fork Stillwater rivers. Triplicate samples were collected from the Boulder River.

Community composition

Replicate samples from the Boulder River were quite similar with QSI-taxa values averaging 76%. Among the five reference streams, QSI-taxa values ranged from 63 to 30% (Table 3). Streams were loosely grouped by geographic region (Figure 2) with the Boulder and West Fork Stillwater rivers forming one cluster and the North Fork Teton and South Fork Sun rivers comprising a second group.

Metrics

Metric values from mountain reference streams for 1990, 1991 and 1993 are listed in Table 6. Mean site-specific variability between years was less than 30% for most metrics. The % Chironomidae and % Baetidae of total Ephemeroptera had the highest site-specific variability and probably should not be used to assess biointegrity in mountain streams. Replacing the % Chironomidae metric with the % EPT should improve impact assessments of mountain streams. The % Hydropsychinae of total Trichoptera metric did not appear to be generally applicable to mountain streams, but may be useful in selected situations.

The mountain reference stream data (Table 7) provide a good baseline for defining upper endpoints (nonimpaired category) for bioassessments in this ecoregion. Nonimpaired streams could be defined as those with metric values within one average deviation of the reference stream mean. While the criteria currently used to assess biological integrity in mountain streams (McGuire 1994) are generally compatible with the reference stream data (Table 8), the scoring criteria for % dominant taxon and the two functional group metrics could be improved. However, an evaluation of data from both impaired and nonimpaired mountain streams is recommended prior to revision.

Figure 2. Average linkage cluster analysis of percent community similarity values within and among mountain reference streams in 1993.

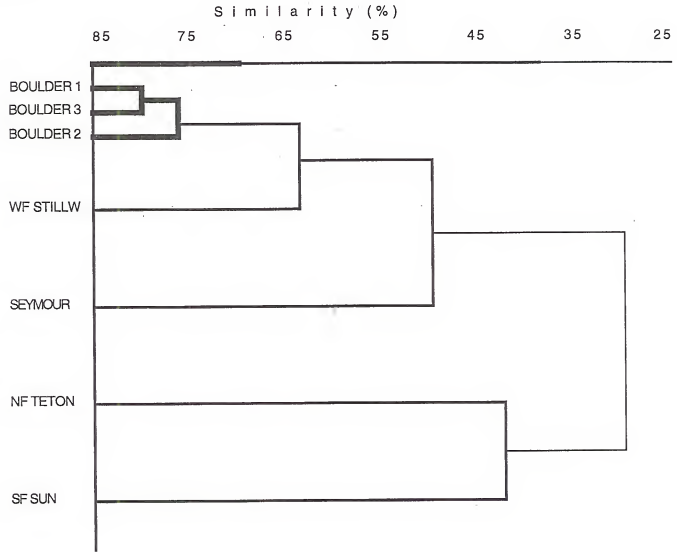

Table 6. Metric variability in mountain ecoregion reference streams over three years.

Metric	STREAM					Mean	Metric	STREAM					Mean
	Bould	WF St	SF Su	Seym	NF Tet	R%Dif		Bould	WF Stw	SF Sun	Seym	NF Tet	R%Dif
Taxa richness							EPT richness						
1990	30	29	36	44			1990	23	20	24	25		
1991	28	24	32	37			1991	19	18	23	29		
1993	30	31	34	35	25		1993	20	22	22	22	16	
AveDif	0.8	2.7	1.3	3.6			AveDif	1.6	1.3	0.7	2.4		
R%Dif	3%	10%	4%	9%		6%	R%Dif	8%	7%	3%	10%		7%
Biotic index							% Baetidae-Ephemeroptera						
1990	1.7	1.6	2.0	2.7			1990	21	8	6	15		
1991	1.8	1.0	1.2	1.5			1991	39	13	10	10		
1993	1.0	0.9	2.1	1.3	0.5		1993	7	19	24	42	0	
AveDif	0.3	0.3	0.4	0.6			AveDif	11	6	9	17		
R%Dif	22%	25%	21%	32%		25%	R%Dif	50%	41%	71%	77%		60%
S. diversity							% Dominant						
1990	3.6	3.3	4.1	4.8			1990	26	35	23	11		
1991	3.3	2.8	3.5	4.5			1991	30	36	24	15		
1993	3.3	3.3	3.8	3.4	2.8		1993	41	36	19	30	38	
AveDif	0.1	0.2	0.2	0.5			AveDif	6	0	2	8		
R%Dif	3%	7%	6%	13%		7%	R%Dif	18%	1%	9%	40%		17%
% Chironomidae							% EPT						
1990	2	6	13	26			1990	97	92	85	69		
1991	5	1	2	10			1991	93	97	94	81		
1993	8	5	23	8	4		1993	90	92	74	88	95	
AveDif	2	2	7	8			AveDif	2	2	7	7		
R%Dif	40%	50%	56%	52%		49%	R%Dif	3%	2%	8%	9%		5%

Table 6. Metric variability in mountain ecoregion reference streams over three years.

Metric	STREAM					Mean	Metric	STREAM					Mean
	Bould	WF St	SF Su	Seym	NF Tet	R%Dif		Bould	WF Stw	SF Sun	Seym	NF Tet	R%Dif
% Collectors-gatherers							% Scrapers						
1990	27	19	25	41			1990	60	53	54	33		
1991	36	17	12	23			1991	47	71	74	44		
1993	34	39	43	43	13		1993	52	48	49	40	72	
AveDif	4	9	11	8			AveDif	5	9	10	4		
R%Dif	11%	37%	41%	24%		28%	R%Dif	9%	16%	17%	10%		13%
% Collectors (g + f)							% Scrapers + Shredders						
1990	28	20	28	53			1990	61	59	60	39		
1991	39	18	14	37			1991	50	72	75	49		
1993	34	40	44	48	14		1993	54	49	49	42	78	
AveDif	4	9	10	6			AveDif	4	8	9	4		
R%Dif	11%	36%	36%	13%		24%	R%Dif	7%	13%	15%	9%		11%

Table 7. Summary of metric values for mountain reference streams in Montana.

METRIC	MEANS 1990	1991	1993	all	min	max	Ave Dif	R%Dif
n=	4	4	5	13				
Taxa richness	35	30	33	32	24	43	4	13%
EPT richness	23	22	21	22	16	29	3	12%
Biotic index	2.0	1.4	1.2	1.5	0.5	2.7	0.5	31%
Melals tolerance index			1.5	1.5	0.5	3.0	0.7	50%
% dominant	24	26	33	28	11	41	8	27%
Shannon diversity	4.0	3.5	3.3	3.6	2.8	4.8	0.5	13%
% Chironomidae	12	5	10	9	1	26	6	72%
% EPT	86	91	88	88	69	97	7	8%
EPT/EPTC	0.88	0.95	0.90	0.91	0.72	0.99	0.06	7%
% Baetidae-Ephem.	0.13	0.18	0.18	0.16	0.00	0.42	0.10	59%
% Hydropsychinae-Trich	0.00	0.00	0.00	0.00	0.00	0.01	0.00	185%
% Collector-gatherer	27	19	34	27	12	43	9	33%
% Collector-filterer	4	9	2	5	0	17	5	98%
% Collector (G+F)	31	28	36	32	14	50	10	31%
% Scraper	56	60	52	56	35	76	12	21%
% Shredder	4	5	2	4	0	12	2	70%
% Scraper+Shredder	60	65	54	59	41	78	11	19%
Scraper/(Scrap.+Filt.)	0.92	0.91	0.97	0.94	0.75	1.00	0.07	7%

Table 8. Mean metric values for mountain reference streams, potential nonimpaired endpoints (mean + or - average difference) and current* scoring criteria for mountain ecoregion streams.

	Mountain Reference streams		Impairment Catagory and Scoring Criteria			
		nonimpaired	non	slight	moderate	severe
metric	mean	endpoint	6	4	2	0
Taxa richness	32	28	>28	28-24	24-19	<19
EPT richness	22	19	>19	19-18	17-16	<16
Biotic index	1.5	2	<3	3 - 4	4 - 5	>5
% dominant taxon	28	35	<25	25-35	35-45	>45
% Collectors:(G+F)	32	42	<60	60-70	70-80	>80
% Scrapers+Shredders	59	48	>55	55-40	40-25	<25
% Chironomidae	9	15	<25	25-35	35-45	>45
% EPT	86	79				

* McGuire 1994

ARMSTRONG SPRING CREEK

RBP samples were collected from Armstrong Spring Creek in 1990, 1991 and 1993. Selected metric values for the three years are presented in Table 9. With the exception of metrics incorporating EPT abundance, metric variability between years was low. These data may serve as a baseline for evaluating impacts in other spring creeks in the plains and foothills ecoregion.

TABLE 9. Selected metrics characterizing the biological integrity in Armstrong Spring Creek during 1990, 1991 and 1993.

Metric	1990*	1991	1993	Mean	Ave Dev	R%Dif
Taxa richness	20	19	22	20	1.1	5%
EPT richness	5	3	4	4	0.7	17%
Biotic Index	5.3	5.7	4.8	5.3	0.3	6%
% RA dominant taxon	20	22	34	25	5.8	23%
Shannon diversity	3.2	3.3	3.3	3.2	0.0	1%
%Baetidae-Ephemeroptera	100	85	96	94	5.8	6%
% Chironomidae	39	65	35	46	12.4	27%
% EPT	33	4	37	25	13.8	56%
EPT/ EPTC	0.46	0.06	0.52	0.35	0.19	55%
% RA Scrapers	15	10	9	11	2.4	22%
% RA Collector-gatherers	76	67	62	68	5.1	7%
% Scrapers + Shredders	17	14	15	15	1.1	7%
% Collectors (g+f)	78	68	69	72	4.2	6%

*adapted from Wisseman 1992 (to ~ 300 organisms).

Conclusions and Recommendations

Data for plains reference streams were highly variable and did not provide an adequate baseline for establishing RBP criteria. Confidence in the usefulness of the data was reduced by several factors:

1. While biointegrity was high in the West Fork Poplar River, this stream does not appear to be characteristic of the plains ecoregion.

2. Battle and Rock creeks appeared to be impaired by organic pollution and poor water quality may make these streams inappropriate as ecosystem references.

3. The 1990 data appeared to be skewed by environmental stresses associated with drought.

At this time, the metrics and criteria used by McGuire (1994) are recommended for general plains ecoregion assessments. Metrics included in this analysis were taxa richness, EPT richness, biotic index, % dominant taxon, % Collectors and % Hydropsychinae of total Trichoptera. An additional metric, % EPT, should improve the overall assessment of plains streams. A re-evaluation of these criteria should be possible when the plains database is enlarged. Additional data from reference streams (1994) and from impaired plains streams (McGuire 1994) should allow a revision of the RBP metrics and criteria for this ecoregion.

The mountain reference stream data provides a good characterization of nonimpaired streams in this ecoregion. Nonimpaired streams could be defined as those with metric values within one average deviation of the reference stream mean. Reference stream data generally supports metric selection and criteria ranges currently used for the mountain ecoregion (McGuire 1994). Replacing the % Chironomidae metric with % EPT will improve assessments for this ecoregion. In addition, scoring criteria for functional feeding group metrics could be improved. However, an evaluation of data from both impaired and nonimpaired mountain streams is recommended prior to refining existing RBP criteria.

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APPENDIX A:

AQUATIC MACROINVERTEBRATE DATA
MONTANA REFERENCE STREAMS
1993

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - W. F. Poplar R.- 23 JUN 1993

stream/location: Taxon	WF Poplar at HWY 13 riffle1	riffle 2	riffle 3	MEAN	ST.DEV.	Co.VAR %
COLEOPTERA						
Dubiraphia sp.	1	0	1	0.7	0.6	87%
DIPTERA						
Ablabesmyia sp.	5	9	9	7.7	2.3	30%
Thienemannimyia gp.	0	1	0	0.3	0.6	173%
Cricotopus spp.	3	3	1	2.3	1.2	49%
Microtendipes sp.	1	1	0	0.7	0.6	87%
Paratanytarsus sp.	6	4	0	3.3	3.1	92%
Rheotanytarsus sp.	0	2	13	5.0	7.0	140%
Tanytarsus sp.	2	0	0	0.7	1.2	173%
Micropsectra spp.	1	1	0	0.7	0.6	87%
Tabanidae	1	3	7	3.7	3.1	83%
Simulium (Eusimulium)	4	10	31	15.0	14.2	95%
EPHEMEROPTERA						
Acentrella sp.	1	3	0	1.3	1.5	115%
Baetis sp.	32	46	40	39.3	7.0	18%
Caenis sp.	2	1	1	1.3	0.6	43%
Isonychia sp.	5	12	9	8.7	3.5	41%
Nixe sp.	61	50	56	55.7	5.5	10%
Tricorythodes sp.	135	109	67	103.7	34.3	33%
TRICHOPTERA						
Cheumatopsyche sp.	2	12	23	12.3	10.5	85%
Hydropsyche bronta	3	9	18	10.0	7.5	75%
Hydroptila spp.	2	1	4	2.3	1.5	65%
Ithytrichia sp.	1	0	0	0.3	0.6	173%
Mystacides sp.	1	0	0	0.3	0.6	173%
Oecetis sp.	0	0	1	0.3	0.6	173%
Polycentropus sp.	7	4	3	4.7	2.1	45%
Helicopsyche borealis	0	0	1	0.3	0.6	173%
HEMIPTERA						
Sigara sp.	18	3	0	7.0	9.6	138%
ANNELIDA						
Tubificidae	1	0	0	0.3	0.6	173%
CRUSTACEA						
Decapoda	1	3	2	2.0	1.0	50%

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - W. F. Poplar R.- 23 JUN 1993

stream/location: Taxon	WF Poplar riffle1	at riffle 2	HWY 13 riffle 3	MEAN	ST.DEV.	Co.VAR %
Gammarus sp.	19	7	13	13.0	6.0	46%
Hyalella azteca	2	5	6	4.3	2.1	48%
MOLLUSCA						
Physidae	1	0	0	0.3	0.6	173%
IDs by D. McGuire						
TOTAL ORGANISMS	318	299	306	308	10	3%
TAXA RICHNESS	27	23	20	23.3	3.5	15%
EPT RICHNESS	12	10	11	11.0	1.0	9%
BIOTIC INDEX	4.45	4.54	4.73	4.6	0.1	3%
% DOMINANT TAXON	42%	36%	22%	34%	11%	31%
SHANNON DIVERSITY	2.91	3.13	3.42	3.2	0.26	8%
Hydropsychinae/TRICH	31%	81%	82%	65%	29%	45%
Baetidae/EPHEMEROPTERA	14%	22%	23%	20%	5%	25%
EPT/(EPT + Chironomidae)	0.93	0.92	0.91	0.92	0.01	1%
% COLL-FILTERERS	5%	15%	31%	17%	13%	76%
% COLL-GATHERERS	58%	58%	38%	51%	12%	23%
% SHREDDERS	6%	3%	5%	5%	1%	30%
% SCRAPERS	20%	17%	20%	19%	2%	10%
% PREDATORS	10%	7%	7%	8%	2%	24%
% COLLECTORS	64%	73%	69%	68%	5%	7%
Scrap/(scrap+filt)	0.80	0.53	0.39	58%	0.21	36%
% CHIRONOMIDAE	6%	7%	8%	7%	1%	14%
% COLEOPTERA	0%	0%	0%	0%	0%	87%
% DIPTERA	7%	11%	20%	13%	6%	50%
% EPHEMEROPTERA	74%	74%	57%	68%	10%	15%
% TRICHOPTERA	5%	9%	16%	10%	6%	58%
% misc INSECTS	6%	1%	0%	2%	3%	136%
% ANNELIDA	0%	0%	0%	0%	0%	173%
% MOLLUSCA	0%	0%	0%	0%	0%	173%
% CRUSTACEA	7%	5%	7%	6%	1%	17%

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - 1993
WF POPLAR R

	% Relative abundance			
	riffle1	riffle 2	riffle 3	mean
Dubiraphia sp.	0.3%	0.0%	0.3%	0.2%
DIPTERA				
Ablabesmyia sp.	1.6%	3.0%	2.9%	2.5%
Thienemannimyia gp.	0.0%	0.3%	0.0%	0.1%
Cricotopus spp.	0.9%	1.0%	0.3%	0.8%
Microtendipes sp.	0.3%	0.3%	0.0%	0.2%
Paratanytarsus sp.	1.9%	1.3%	0.0%	1.1%
Rheotanytarsus sp.	0.0%	0.7%	4.2%	1.6%
Tanytarsus sp.	0.6%	0.0%	0.0%	0.2%
Micropsectra spp.	0.3%	0.3%	0.0%	0.2%
Tabanidae	0.3%	1.0%	2.3%	1.2%
Simulium (Eusimulium)	1.3%	3.3%	**10.1%**	**4.9%**
EPHEMEROPTERA				
Acentrella sp.	0.3%	1.0%	0.0%	0.4%
Baetis sp.	**10.1%**	**15.4%**	**13.1%**	**12.8%**
Caenis sp.	0.6%	0.3%	0.3%	0.4%
Isonychia sp.	1.6%	**4.0%**	2.9%	2.8%
Nixe sp.	**19.2%**	**16.7%**	**18.3%**	**18.1%**
Tricorythodes sp.	**42.5%**	**36.5%**	**21.9%**	**33.6%**
TRICHOPTERA				
Cheumatopsyche sp.	0.6%	**4.0%**	**7.5%**	4.1%
Hydropsyche bronta	0.9%	3.0%	5.9%	3.3%
Hydroptila spp.	0.6%	0.3%	1.3%	0.8%
Ithytrichia sp.	0.3%	0.0%	0.0%	0.1%
Mystacides sp.	0.3%	0.0%	0.0%	0.1%
Oecetis sp.	0.0%	0.0%	0.3%	0.1%
Polycentropus sp.	2.2%	1.3%	1.0%	1.5%
Helicopsyche borealis	0.0%	0.0%	0.3%	0.1%
HEMIPTERA				
Sigara sp.	**5.7%**	1.0%	0.0%	2.2%
	0.0%	0.0%	0.0%	0.0%
ANNELIDA				
Tubificidae	0.3%	0.0%	0.0%	0.1%
CRUSTACEA				
Decapoda	0.3%	1.0%	0.7%	0.7%

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - 1993
WF POPLAR R

	% Relative abundance			
	riffle1	riffle 2	riffle 3	mean
Gammarus sp.	6.0%	2.3%	4.2%	4.2%
Hyalella azteca	0.6%	1.7%	2.0%	1.4%
MOLLUSCA				
Physidae	0.3%	0.0%	0.0%	0.1%

QSI-taxa	QSI-taxa	QSI- ffg	DIC-5
1 vs 2	79%	90%	3
1 vs 3	64%	75%	3
2 vs 3	76%	70%	4

ATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - 1993

stream/location:	Battle Cr	
Taxon	nr Chinook	%RA
DIPTERA		
Cricotopus spp.	14	**4.4%**
Tanytarsus sp.	2	0.6%
Micropsectra spp.	1	0.3%
Ceratopogoninae	2	0.6%
Simulium (Eusimulium)	192	**59.8%**
EPHEMEROPTERA		
Psuedocloeon sp.	8	2.5%
Caenis sp.	9	**2.8%**
Ephoron a.	1	0.3%
Isonychia sp.	1	0.3%
Nixe sp.	2	0.6%
TRICHOPTERA		
Cheumatopsyche sp.	66	**20.6%**
Hydropsyche bronta	7	2.2%
ANNELIDA		
Erpobdellidae	1	0.3%
CRUSTACEA		
Hyalella azteca	15	**4.7%**

TOTAL ORGANISMS	321
TAXA RICHNESS	14
EPT RICHNESS	7
BIOTIC INDEX	5.25
% DOMINANT TAXON	60%
SHANNON DIVERSITY	1.95
Hydropsychinae/TRICH	100%
Baetidae/EPHEMEROPTERA	38%
EPT/(EPT + Chironomidae)	0.85
% COLL-FILTERERS	83%
% COLL-GATHERERS	15%
% SHREDDERS	0%
% SCRAPERS	1%
% PREDATORS	1%
% COLLECTORS	98%
Scrap/(scrap+filt)	0.01
% CHIRONOMIDAE	5%
% COLEOPTERA	0%
% DIPTERA	66%
% EPHEMEROPTERA	7%
% TRICHOPTERA	23%
% CRUSTACEA	5%

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - 1993

stream/location:	Redwater	Rock Cr.	MEAN	ST.DEV.	Co.VAR	% Relative abundance	
Taxon	HWY201	Hinsdale			%	Redwater	Rock Cr.
DIPTERA							
Ablabesmyia sp.	8	13				2.6%	4.4%
Cricotopus spp.	2	4				0.7%	1.4%
Cryptochironomus sp.	0	2				0.0%	0.7%
Pseudochironomus sp.	24	0				7.8%	0.0%
Paratanytarsus sp.	1	0				0.3%	0.0%
Tanytarsus sp.	0	1				0.0%	0.3%
Simulium (Psilozia)	6	229				2.0%	78.2%
EPHEMEROPTERA							
Baetis sp.	4	0				1.3%	0.0%
Callibaetis sp.	3	0				1.0%	0.0%
Caenis sp.	5	5				1.6%	1.7%
TRICHOPTERA							
Cheumatopsyche sp.	80	3				26.1%	1.0%
Hydropsyche bronta	118	0				38.6%	0.0%
Ithytrichia sp.	1	1				0.3%	0.3%
HEMIPTERA							
Sigara sp.	39	3				12.7%	1.0%
						0.0%	0.0%
ODONATA						0.0%	0.0%
Enallagma sp.	0	1				0.0%	0.3%
CRUSTACEA							
Gammarus sp.	0	3				0.0%	1.0%
Hyalella azteca	15	23				4.9%	7.8%
MOLLUSCA							
Physidae	0	5				0.0%	1.7%

IDs by D. McGuire

AQUATIC MACROINVERTEBRATE DATA RBP KICK SAMPLES
Plains Reference Streams - 1993

stream/location:	Redwater	Rock Cr.	MEAN	ST.DEV.	Co.VAR	% Relative abundance	
Taxon	HWY201	Hinsdale			%	Redwater	Rock Cr.
TOTAL ORGANISMS	306	293	300	9	3%		
TAXA RICHNESS	13	13	13.0	0.0	0%	QSI-taxa	14%
EPT RICHNESS	6	3	4.5	2.1	47%		
BIOTIC INDEX	5.35	7.06	6.2	1.2	20%		
% DOMINANT TAXON	39%	78%	58%	28%	48%	QSI-ffg	84%
SHANNON DIVERSITY	2.51	1.39	1.9	0.79	41%		
Hydropsychinae/TRICH	99%	75%	87%	17%	20%	DIC-5	1
Baetidae/EPHEMEROPTERA	58%	0%	29%	41%	141%		
EPT/(EPT + Chironomidae)	0.86	0.31	0.58	0.39	66%		
% COLL-FILTERERS	67%	80%	73%	9%	12%		
% COLL-GATHERERS	18%	12%	15%	4%	29%		
% SHREDDERS	0%	1%	1%	1%	141%		
% SCRAPERS	0%	2%	1%	1%	102%		
% PREDATORS	15%	6%	11%	7%	64%		
% COLLECTORS (g+f)	84%	91%	88%	5%	5%		
% CHIRONOMIDAE	11%	7%	9%	3%	36%		
% COLEOPTERA	0%	0%	0%	0%	#####		
% DIPTERA	13%	85%	49%	51%	103%		
% EPHEMEROPTERA	4%	2%	3%	2%	56%		
% PLECOPTERA	0%	0%	0%	0%	#####		
% TRICHOPTERA	65%	1%	33%	45%	136%		
% misc INSECTS	13%	1%	7%	8%	114%		
% ANNELIDA	0%	0%	0%	0%	#####		
% MULLUSCA	0%	2%	1%	1%	141%		
% CRUSTACEA	5%	9%	7%	3%	41%		
% misc NONINSECTS	0%	0%	0%	0%	#####		

AQUATIC MACROINVERTEBRATE DATA
1993 mountain reference streams - Boulder River

Stream:	Boulder R			MEAN	ST. DEV.	Co.VAR%	% Relative abund.		
Taxon	R1	R2	R3				R1	R2	R3
COLEOPTERA									
Heterlimnius sp.	1	1	0	0.7	0.6	87%	0.3%	0.3%	0.0%
DIPTERA									
Diamesa sp.	2	1	0	1.0	1.0	100%	0.6%	0.3%	0.0%
Pagastia sp.	1	11	1	4.3	5.8	133%	0.3%	3.7%	0.3%
Cricotopus sp.	1	5	1	2.3	2.3	99%	0.3%	1.7%	0.3%
Eukiefferiella spp.	0	1	0	0.3	0.6	173%	0.0%	0.3%	0.0%
Orthocladius sp.	0	2	0	0.7	1.2	173%	0.0%	0.7%	0.0%
Parametriocnemus sp.	0	0	1	0.3	0.6	173%	0.0%	0.0%	0.3%
Rheocricotopus sp.	0	1	2	1.0	1.0	100%	0.0%	0.3%	0.7%
Tvetenia sp.	1	1	0	0.7	0.6	87%	0.3%	0.3%	0.0%
Micropsectra sp.	9	10	17	12.0	4.4	36%	2.8%	3.3%	5.8%
Hexatoma sp.	0	5	4	3.0	2.6	88%	0.0%	1.7%	1.4%
Rhabdomastix sp.	4	0	1	1.7	2.1	125%	1.2%	0.0%	0.3%
Ceratopogoninae	1	0	0	0.3	0.6	173%	0.3%	0.0%	0.0%
Simulium spp. (Eusimulium)	0	0	1	0.3	0.6	173%	0.0%	0.0%	0.3%
EPHEMEROPTERA									
Baetis tricaudatus	4	11	11	8.7	4.0	47%	1.2%	3.7%	3.8%
Baetis bicaudatus	7	4	9	6.7	2.5	38%	2.2%	1.3%	3.1%
Drunella coloradensis	15	23	13	17.0	5.3	31%	4.6%	7.7%	4.5%
Drunella doddsi	5	12	12	9.7	4.0	42%	1.5%	4.0%	4.1%
Drunella spinifera	1	0	0	0.3	0.6	173%	0.3%	0.0%	0.0%
Ephemerella infrequens	3	4	2	3.0	1.0	33%	0.9%	1.3%	0.7%
Serratella sp.	42	48	33	41.0	7.5	18%	13.0%	16.1%	11.3%
Cinygmula sp.	157	97	124	126.0	30.0	24%	48.6%	32.4%	42.6%
Epeorus deceptivus	0	3	2	1.7	1.5	92%	0.0%	1.0%	0.7%
Epeorus longimanus	3	12	11	8.7	4.9	57%	0.9%	4.0%	3.8%
Rhithrogena sp.	24	5	9	12.7	10.0	79%	7.4%	1.7%	3.1%
Ameletus sp.	1	6	0	2.3	3.2	138%	0.3%	2.0%	0.0%
PLECOPTERA									
Chloroperlinae	20	8	9	12.3	6.7	54%	6.2%	2.7%	3.1%
Zapada oregensis gp.	2	5	4	3.7	1.5	42%	0.6%	1.7%	1.4%
Doroneuria sp.	4	6	5	5.0	1.0	20%	1.2%	2.0%	1.7%
Kogotus sp.	5	5	5	5.0	0.0	0%	1.5%	1.7%	1.7%
Megarcys sp.	1	1	2	1.3	0.6	43%	0.3%	0.3%	0.7%

AQUATIC MACROINVERTEBRATE DATA

1993 mountain reference streams - Boulder River

Stream:	Boulder R			MEAN	ST. DEV.	Co.VAR%	% Relative abund.		
Taxon	R1	R2	R3				R1	R2	R3
TRICHOPTERA									
Ecclisomyia sp.	0	1	0	0.3	0.6	173%	0.0%	0.3%	0.0%
Oligophlebodes sp.	0	1	2	1.0	1.0	100%	0.0%	0.3%	0.7%
Rhyacophila alberta gp.	0	0	2	0.7	1.2	173%	0.0%	0.0%	0.7%
Rhyacophila angelita gp.	5	1	3	3.0	2.0	67%	1.5%	0.3%	1.0%
Rhyacophila brunnea gp.	2	6	2	3.3	2.3	69%	0.6%	2.0%	0.7%
Rhyacophila hyalinata gp.	0	1	1	0.7	0.6	87%	0.0%	0.3%	0.3%
Rhyacophila vofixa gp.	0	0	1	0.3	0.6	173%	0.0%	0.0%	0.3%
OTHER									
Enchytraeidae	0	0	1	0.3	0.6	173%	0.0%	0.0%	0.3%
Turbellaria	2	1	0	1.0	1.0	100%	0.6%	0.3%	0.0%

TOTAL ORGANISMS	323	299	291	304	17	5%		QSI-taxa	
TAXA RICHNESS	27	32	30	29.7	2.5	8%	1 vs 2	0.701	
EPT RICHNESS	18	21	21	20.0	1.7	9%	1 vs 3	0.803	
BIOTIC INDEX	0.75	1.24	1.02	1.0	0.2	24%	2 vs 3	0.793	
% DOMINANT TAXON	49%	32%	43%	41%	8%	20%			
% CHIRONOMIDAE	4%	11%	8%	8%	3%	42%		QSI-ffg	
Hydropsychinae/TRICH	0%	0%	0%	0%	0%	#DIV/0!	1 vs 2	0.82	
Baetidae/EPHEMEROPTERA	4%	7%	9%	7%	2%	35%	1 vs 3	0.95	
% COLLECTORS (g+f)	27%	43%	32%	34%	9%	25%	2 vs 3	0.86	
% SCRAPER+SHREDDER	59%	45%	56%	54%	8%	14%			
SHANNON DIVERSITY	2.91	3.68	3.34	3.31	0.38	12%		DIC-5	
METALS TOLERANCE INDEX	0.86	1.34	0.90	1.0	0.3	26%	1 vs 2	3	
EPT/(EPT + Chironomidae)	0.96	0.89	0.92	0.92	0.03	4%	1 vs 3	3	
% FILTERERS	0%	0%	0%	0%	0%	173%	2 vs 3	4	
% COLLECTOR-GATHERERS	27%	43%	31%	34%	9%	25%			
% SHREDDERS	1%	2%	1%	1%	1%	44%			
% SCRAPERS	59%	43%	55%	52%	8%	15%			
% PREDATORS	14%	11%	12%	12%	1%	9%			
Scraper/(Scraper+Filterer)	100%	100%	99%	100%	0%	0%			
% COLEOPTERA	0%	0%	0%	0%	0%	87%			
% DIPTERA	6%	12%	10%	9%	3%	35%			
% EPHEMEROPTERA	81%	75%	78%	78%	3%	4%			
% PLECOPTERA	10%	8%	9%	9%	1%	9%			
% TRICHOPTERA	2%	3%	4%	3%	1%	27%			

AQUATIC MACROINVERTEBRATE DATA
1993 mountain reference streams - West Fork Stillwater River

Stream:	WFStillwater	%RA
Taxon		
DIPTERA		
Diamesa sp.	2	0.6%
Eukiefferiella spp.	1	0.3%
Orthocladius sp.	1	0.3%
Tvetenia sp.	1	0.3%
Micropsectra sp.	9	2.9%
Dicranota sp.	2	0.6%
Hexatoma sp.	2	0.6%
Rhabdomastix sp.	4	1.3%
Simulium spp. (Eusimulium)	1	0.3%
EPHEMEROPTERA		
Baetis tricaudatus	18	**5.8%**
Baetis bicaudatus	30	**9.7%**
Caudatella hystrix	1	0.3%
Drunella coloradensis	56	**18.2%**
Drunella doddsi	3	1.0%
Drunella spinifera	1	0.3%
Ephemerella infrequens	1	0.3%
Cinygmula sp.	111	**36.0%**
Epeorus deceptivus	7	2.3%
Epeorus longimanus	19	**6.2%**
Rhithrogena sp.	6	1.9%
PLECOPTERA		
Chloroperlinae	11	3.6%
Zapada oregensis gp.	2	0.6%
Doroneuria sp.	2	0.6%
Kogotus sp.	2	0.6%
Megarcys sp.	1	0.3%
Pictetiella sp.	1	0.3%
TRICHOPTERA		
Parapsyche sp.	2	0.6%
Rhyacophila alberta gp.	2	0.6%
Rhyacophila betteni gp.	4	1.3%
Rhyacophila brunnea gp.	3	1.0%
Rhyacophila sibirica gp.	2	0.6%

AQUATIC MACROINVERTEBRATE DATA

1993 mountain reference streams - West Fork Stillwater River

Stream:	WFStillwater	%RA
Taxon		
TOTAL ORGANISMS	308	
TAXA RICHNESS	31	
EPT RICHNESS	22	
BIOTIC INDEX	0.86	
% DOMINANT TAXON	36%	
% CHIRONOMIDAE	5%	
Hydropsychinae/TRICH	0%	
Baetidae/EPHEMEROPTERA	19%	
EPT/(EPT + Chironomidae)	0.95	
SHANNON DIVERSITY	3.31	
METALS TOLERANCE INDEX	1.08	
% FILTERERS	1%	
% COLLECTOR-GATHERERS	39%	
% SHREDDERS	1%	
% SCRAPERS	48%	
% PREDATORS	12%	
% COLLECTORS (g+f)	40%	
% SCRAPER+SHREDDER	49%	
Scraper/(Scraper+Filterer)	98%	
% COLEOPTERA	0%	
% DIPTERA	7%	
% EPHEMEROPTERA	82%	
% PLECOPTERA	6%	
% TRICHOPTERA	4%	

AQUATIC MACROINVERTEBRATE DATA

1993 Reference streams: Seymour Cr, NF Teton R & SF Sun R

Stream:	Seymour	NF Teton	SF Sun	% Relative abundance		
Taxon				Seymour	NF Teton	SF Sun
COLEOPTERA						
Heterlimnius sp.	3	0	4	1.0%	0.0%	1.3%
DIPTERA						
Diamesa sp.	1	2	1	0.3%	0.6%	0.3%
Pagastia sp.	0	1	23	0.0%	0.3%	**7.7%**
Cricotopus sp.	0	2	22	0.0%	0.6%	7.4%
Eukiefferiella spp.	6	3	3	2.0%	1.0%	1.0%
Orthocladius sp.	0	0	12	0.0%	0.0%	4.0%
Parametriocnemus sp.	1	1	0	0.3%	0.3%	0.0%
Rheocricotopus sp.	0	1	0	0.0%	0.3%	0.0%
Tvetenia sp.	2	4	3	0.7%	1.3%	1.0%
Polypedilum sp.	0	0	2	0.0%	0.0%	0.7%
Micropsectra sp.	14	0	1	**4.7%**	0.0%	0.3%
Dicranota sp.	1	0	0	0.3%	0.0%	0.0%
Hexatoma sp.	1	1	1	0.3%	0.3%	0.3%
Empididae	0	0	2	0.0%	0.0%	0.7%
Prosimulium sp.	3	1	0	1.0%	0.3%	0.0%
Simulium spp. (Eusimulium)	0	0	2	0.0%	0.0%	0.7%
EPHEMEROPTERA						
Baetis tricaudatus	0	0	42	0.0%	0.0%	**14.1%**
Baetis bicaudatus	89	0	0	**30.1%**	0.0%	0.0%
Drunella coloradensis	5	24	4	1.7%	**7.7%**	1.3%
Drunella doddsi	2	4	19	0.7%	1.3%	6.4%
Drunella spinifera	0	1	0	0.0%	0.3%	0.0%
Ephemerella alleni	2	0	0	0.7%	0.0%	0.0%
Serratella sp.	0	1	8	0.0%	0.3%	2.7%
Cinygmula sp.	76	92	56	**25.7%**	**29.4%**	**18.9%**
Epeorus deceptivus	3	118	40	1.0%	**37.7%**	**13.5%**
Epeorus grandis	2	0	0	0.7%	0.0%	0.0%
Epeorus longimanus	30	9	2	**10.1%**	2.9%	0.7%
Rhithrogena sp.	4	2	0	1.4%	0.6%	0.0%
Ameletus sp.	0	1	2	0.0%	0.3%	0.7%
PLECOPTERA						
Chloroperlinae	3	15	2	1.0%	**4.8%**	0.7%
Kathroperla sp.	1	0	0	0.3%	0.0%	0.0%
Capniidae	3	0	0	1.0%	0.0%	0.0%
Yoraperla sp.	1	0	0	0.3%	0.0%	0.0%
Zapada oregenensis gp.	4	17	1	1.4%	**5.4%**	0.3%
Hesperperla pacifica	0	0	1	0.0%	0.0%	0.3%
Doroneuria sp.	5	0	1	1.7%	0.0%	0.3%
Kogotus sp.	3	0	6	1.0%	0.0%	2.0%
Megarcys sp.	1	7	1	0.3%	2.2%	0.3%

AQUATIC MACROINVERTEBRATE DATA

1993 Reference streams: Seymour Cr, NF Teton R & SF Sun R

Stream:	Seymour	NF Teton	SF Sun	% Relative abundance		
Taxon				Seymour	NF Teton	SF Sun
TRICHOPTERA						
Parapsyche sp.	12	2	0	**4.1%**	0.6%	0.0%
Dicosmoecus sp.	0	0	1	0.0%	0.0%	0.3%
Neophylax sp.	0	0	1	0.0%	0.0%	0.3%
Brachycentrus americanus	0	0	27	0.0%	0.0%	**9.1%**
Wormaldia sp.	0	0	1	0.0%	0.0%	0.3%
Rhyacophila alberta gp.	1	0	0	0.3%	0.0%	0.0%
Rhyacophila angelita gp.	0	0	1	0.0%	0.0%	0.3%
Rhyacophila betteni gp.	3	2	1	1.0%	0.6%	0.3%
Rhyacophila brunnea gp.	0	0	3	0.0%	0.0%	1.0%
Rhyacophila hyalinata gp.	2	1	0	0.7%	0.3%	0.0%
Rhyacophila sibirica gp.	1	0	1	0.3%	0.0%	0.3%
Rhyacophila verrula	2	1	0	0.7%	0.3%	0.0%
Rhyacophila vofixa gp.	5	0	0	1.7%	0.0%	0.0%
OTHERS						
Turbellaria	1	0	0	0.3%	0.0%	0.0%
Enchytraeidae	3	0	0	1.0%	0.0%	0.0%

TOTAL ORGANISMS	296	313	297
TAXA RICHNESS	35	25	34
EPT RICHNESS	24	16	22
BIOTIC INDEX	1.31	0.48	2.08
% DOMINANT TAXON	30%	38%	19%
% CHIRONOMIDAE	8%	4%	23%
Hydropsychinae/TRICH	0%	0%	0%
Baetidae/EPHEMEROPTERA	42%	0%	24%
EPT/(EPT + Chironomidae)	0.92	0.95	0.77
SHANNON DIVERSITY	3.44	2.76	3.84
METALS TOLERANCE INDEX	1.76	0.51	3.03
% FILTERERS	5%	1%	1%
% COLLECTOR-GATHERERS	43%	13%	43%
% SHREDDERS	3%	5%	0%
% SCRAPERS	40%	72%	49%
% PREDATORS	10%	9%	7%
% COLLECTORS (g+f)	48%	14%	44%
% SCRAPER+SHREDDER	42%	78%	49%
Scraper/(Scraper+Filterer)	89%	99%	98%
% COLEOPTERA	1%	0%	1%
% DIPTERA	10%	5%	24%
% EPHEMEROPTERA	72%	81%	58%
% PLECOPTERA	7%	12%	4%
% TRICHOPTERA	9%	2%	12%

	QSI-taxa	QSI-ffg	DIC-5
1 vs 2	40.1%	66.0%	2
1 vs 3	29.6%	91.0%	2
2 vs 3	41.5%	70.0%	2

AQUATIC MACROINVERTEBRATE DATA
ARMSTRONG SPRING CREEK - 20 July 93

Taxon	Number	%RA
COLEOPTERA		0.7%
Heterlimnius sp.	1	0.3%
Brychius sp.	1	0.3%
DIPTERA		40.3%
Pagastia sp.	39	13.0%
Potthastia longimanus	1	0.3%
Prodiamesa sp.	1	0.3%
Cardiocladius sp.	8	2.7%
Cricotopus spp.	42	14.0%
Eukiefferiella spp.	3	1.0%
Synorthocladius sp.	1	0.3%
Tanytarsus sp.	8	2.7%
Phaenopsectra sp.	1	0.3%
Simulium sp.	17	5.7%
EPHEMEROPTERA		35.3%
Baetis tricaudatus	102	34.0%
Tricorythodes sp.	1	0.3%
Ephemerella inermis	3	1.0%
TRICHOPTERA		
Brachycentrus occidentalis	5	1.7%
CRUSTACEA		10.3%
Gammarus sp.	18	6.0%
Caecidotea sp.	13	4.3%
MOLLUSCA		9.3%
Sphaerium sp.	2	0.7%
Lymnaeidae	11	3.7%
Physidae	15	5.0%
ANNELIDA		
Naididae	7	2.3%

ID's by D. McGuire

AQUATIC MACROINVERTEBRATE DATA
ARMSTRONG SPRING CREEK - 20 July 93

TOTAL ORGANISMS	300
TAXA RICHNESS	22
EPT RICHNESS	4
BIOTIC INDEX	4.77
SHANNON DIVERSITY	3.25
METALS TOLERANCE	5.66
EPT/(EPT + Chironomidae)	0.52
% DOMINANT TAXON	34%
% COLLECTOR-GATHERERS	62%
% SHREDDERS	6%
% SCRAPERS	9%
% FILTERERS	7%
% PREDATORS	16%
COLLECTORS (g+f)	69%
SHREDDERS + SCRAPERS	15%
Scrapers/ Scrapers + Filterers	0.56
% CHIRONOMIDAE	35%
Baetidae/EPHEMEROPTERA	96%
Hydropsychinae/TRICH	0%